

Appl. No. 10/644,523
Amdt. Dated May 30, 2006
Reply to Office Action of February 28, 2006

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the above-identified application:

1. (currently amended) A component, comprising:
a silicon-based substrate; and
a diffusion barrier coating disposed on said substrate, wherein said diffusion barrier coating comprises:
a first isolation layer disposed on said silicon-based substrate;
a first oxygen barrier layer disposed on said first isolation layer; and
a second isolation layer disposed on said first oxygen barrier layer,
wherein said first oxygen barrier layer comprises a SiO_2 -based material, and
wherein said first isolation layer ~~and said second isolation layer each~~ comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , TaSi_2 , MoSi_2 , Mo_5Si_3 , Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$, and SiC ; and
wherein said second isolation layer comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , TaSi_2 , MoSi_2 , and Mo_5Si_3 .
2. (original) The component of claim 1, further comprising:
a second oxygen barrier layer disposed on said second isolation layer; and
a third isolation layer disposed on said second oxygen barrier layer.
3. (original) The component of claim 1, further comprising:
an environmental barrier coating disposed on said diffusion barrier coating.

Appl. No. 10/644,523
Amdt. Dated May 30, 2006
Reply to Office Action of February 28, 2006

4. (original) The component of claim 3, wherein said environmental barrier coating comprises at least one oxide of an element selected from the group consisting of Ta, Al, Cr, Hf, Ti, Zr, Mo, Nb, Ni, Sr, Mg, Si, and the rare earth elements including Sc, Y, and the lanthanide series of elements.

5. (original) The component of claim 4, wherein said environmental barrier coating comprises at least about 50 mole % AlTaO_4 .

6. (original) The component of claim 3, further comprising:
a thermal barrier coating disposed on said environmental barrier coating.

7. (original) The component of claim 1, wherein said first oxygen barrier layer comprises a material selected from the group consisting of a silicate glass and crystalline silica.

8. (original) The component of claim 1, wherein said first oxygen barrier layer comprises silica and at least one oxide of an element selected from the group consisting of Ta, Al, Cr, Hf, Ti, Zr, Mo, Nb, Ni, Sr, Mg, Si, and the rare earth elements including Sc, Y, and the lanthanide series of elements.

9. (original) The component of claim 1, wherein said first isolation layer and said second isolation layer have the same composition.

10. (original) The component of claim 1, wherein:
said first isolation layer consists essentially of silicon nitride;
said second isolation layer consists essentially of Ta_2O_5 ; and
said first oxygen barrier layer is formed *in situ* by reaction of said silicon nitride with said Ta_2O_5 .

11. (original) The component of claim 1, wherein said first oxygen barrier layer has a thickness in the range of from about 1 to 20 microns.

Appl. No. 10/644,523
Amdt. Dated May 30, 2006
Reply to Office Action of February 28, 2006

12. (original) The component of claim 1, wherein said first and second isolation layers each have a thickness in the range of from about 1 to 100 microns.

13. (currently amended) A component, comprising:
a silicon-based substrate; and
a diffusion barrier coating disposed on said substrate, wherein said diffusion barrier coating comprises:
a first isolation layer disposed on said silicon-based substrate;
a first oxygen barrier layer disposed on said first isolation layer;
a second isolation layer disposed on said first oxygen barrier layer; and
an environmental barrier coating disposed on said diffusion barrier coating,
wherein said first oxygen barrier layer provides a barrier to the diffusion of oxygen therethrough, and
wherein each of said first isolation layer and said second isolation layer comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , $TaSi_2$, $MoSi_2$, Mo_5Si_3 , Si_3N_4 , Si_2N_2O , and SiC ; and
wherein said second isolation layer consists essentially of Ta_2O_5 .

14. (original) The component of claim 13, further comprising a thermal barrier coating disposed on said environmental barrier coating, and wherein said environmental barrier coating comprises $AlTaO_4$ or Ta_2O_5 .

15. (original) The component of claim 13, wherein said thermal barrier coating comprises yttria stabilized zirconia r yttria stabilized hafnia.

Appl. No. 10/644,523
Amdt. Dated May 30, 2006
Reply to Office Action of February 28, 2006

16. (currently amended) A component, comprising:
- a silicon-based substrate;
 - a first isolation layer disposed on said silicon-based substrate, wherein said first isolation layer comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , $TaSi_2$, $MoSi_2$, Mo_5Si_3 , Si_3N_4 , Si_2N_2O , and SiC ;
 - a first oxygen barrier layer disposed on said first isolation layer, wherein said first oxygen barrier layer comprises a material selected from the group consisting of a silicate glass, and crystalline silica; and
 - a second isolation layer disposed on said first oxygen barrier layer, wherein said second isolation layer comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , $TaSi_2$, $MoSi_2$, and Mo_5Si_3 , ~~Si_3N_4 , Si_2N_2O , and SiC ,~~
- wherein said first oxygen barrier layer has a thickness in the range of from about 1 to 20 micron, and
- wherein said first and second isolation layers each have a thickness in the range of from about 1 to 100 micron.

Appl. No. 10/644,523
Amdt. Dated May 30, 2006
Reply to Office Action of February 28, 2006

17. (currently amended) A component, comprising:
a silicon-based substrate; and
a diffusion barrier coating disposed on said substrate, wherein said diffusion barrier coating comprises:
a plurality of isolation layers, at least one of said plurality of isolation layers disposed on said silicon-based substrate; and
one or more oxygen barrier layers, each of said one or more oxygen barrier layers disposed between two of said plurality of isolation layers; wherein each of said one or more oxygen barrier layers comprises a SiO₂-based material, and
~~each~~ at least one of said plurality of isolation layers consists essentially ~~comprises a material selected from the group consisting of Ta₂O₅, Ta₃Si₂, TaSi₂, MoSi₂, Mo₃Si₂, Si₃N₄, Si₃N₂O, and SiC of Ta₂O₅~~

18. (original) The component of claim 17, wherein:
said one or more oxygen barrier layers consist of n oxygen barrier layers, and
said plurality of isolation layers consist of (n+1) isolation layers, wherein n is an integer in the range of from 1 to 5.

19. (currently amended) A component, comprising:
a gas turbine engine element including a silicon-based substrate; and
a diffusion barrier coating disposed on said substrate, wherein said diffusion barrier coating comprises:
a first isolation layer disposed on said silicon-based substrate;
a first oxygen barrier layer disposed on said first isolation layer;
a second isolation layer disposed on said first oxygen barrier layer; and
an environmental barrier coating disposed on said second isolation layer,

Appl. No. 10/644,523
Amdt. Dated May 30, 2006
Reply to Office Action of February 28, 2006

wherein said first oxygen barrier layer serves as a barrier to the diffusion of oxygen therethrough,

wherein said first isolation layer is inert to said silicon-based substrate, and

wherein said second isolation layer is inert to said environmental barrier coating.

20. (currently amended) A diffusion barrier coating for a silicon-based substrate, comprising:

a first isolation layer;

a first oxygen barrier layer disposed on said first isolation layer; and

a second isolation layer disposed on said first oxygen barrier layer,

wherein said first oxygen barrier layer comprises a SiO_2 -based material, and

wherein each of said first isolation layer and said second isolation layer

comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , TaSi_2 , MoSi_2 , and Mo_5Si_3 , Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$, and SiC Mo_5Si_3 .

21. (original) The diffusion barrier coating of claim 20, wherein said first isolation layer is disposed on said silicon-based substrate.

22. (currently amended) A component, comprising:

a silicon-based substrate; and

a diffusion barrier coating disposed on said substrate, wherein said diffusion barrier coating comprises:

an isolation layer consisting of Ta_2O_5 , Ta_5Si_3 , TaSi_2 , MoSi_2 , and Mo_5Si_3 disposed on said silicon-based substrate;

a first oxygen barrier layer disposed on said first isolation layer; and

a second oxygen barrier layer disposed on said first oxygen barrier layer,

Appl. No. 10/644,523
Amdt. Dated May 30, 2006
Reply to Office Action of February 28, 2006

wherein each of said first oxygen barrier layer and said second oxygen barrier layer provides a barrier to the diffusion of oxygen therethrough.

23. (Canceled)

24. (original) The component of claim 22, wherein each of said first oxygen barrier layer and said second oxygen barrier layer comprise a material selected from the group consisting of SiO_2 , ScSiO_3 , and $\text{Sc}_2\text{Si}_2\text{O}_7$.

25. (original) The component of claim 22, further comprising:
an environmental barrier coating disposed on said diffusion barrier coating,
and wherein said environmental barrier coating comprises at least about 50 mole % AlTaO_4 .

26. (original) The component of claim 25, further comprising:
a thermal barrier coating disposed on said environmental barrier coating.

27. (currently amended) A method for making a component, the method comprising:
a) providing a silicon-based substrate;
b) forming a first isolation layer selected from the group consisting Ta_2O_5 , Ta_5Si_3 , TaSi_2 , MoSi_2 , and Mo_5Si_2 on said silicon-based substrate;
c) forming a first oxygen barrier layer on said first isolation layer; and
d) forming a second isolation layer on said first oxygen barrier layer,
wherein said first isolation layer isolates said oxygen barrier layer from said silicon-based substrate, and
wherein said first isolation layer is inert to said silicon-based substrate.

28. (Canceled)

Appl. No. 10/644,523

Amdt. Dated May 30, 2006

Reply to Office Action of February 28, 2006

29. (original) The method of claim 27, wherein said first oxygen barrier layer provides a barrier to the diffusion of oxygen therethrough.

30. (original) The method of claim 27, wherein said first isolation layer provides a barrier to the diffusion of constituents of said silicon-based substrate into said first oxygen barrier layer.

31. (original) The method of claim 27, further comprising:
e) forming an environmental barrier coating on said second isolation layer, wherein said second isolation layer provides a barrier to the diffusion of constituents of said environmental barrier coating into said first oxygen barrier layer.

32. (original) The method of claim 31, further comprising:
f) forming a thermal barrier coating on said environmental barrier coating.

33. (original) The method of claim 27, wherein said first isolation layer, said oxygen barrier layer, and said second isolation layer are deposited via a process selected from the group consisting of plasma spray coating, dip coating, sol-gel coating, chemical vapor deposition, physical vapor deposition, and electron beam physical vapor deposition.

34. (original) The method of claim 27, wherein said step b) and said step d) respectively comprise depositing said first isolation layer and said second isolation layer via chemical vapor deposition.

35. (original) The method of claim 27, further comprising:
g) sequentially forming at least one additional oxygen barrier layer and at least one additional isolation layer on said second isolation layer.

Appl. No. 10/644,523
Amdt. Dated May 30, 2006
Reply to Office Action of February 28, 2006

36. (currently amended) A method for making a component, the method comprising:

- a) providing a silicon-based substrate;
- b) forming a first isolation layer on said silicon-based substrate;
- c) forming a first oxygen barrier layer on said first isolation layer;
- d) forming a second isolation layer on said first oxygen barrier layer; and
- e) forming an environmental barrier coating on said second isolation layer,

wherein said first oxygen barrier layer comprises silicate glass, and
wherein said first isolation layer and said second isolation layer each comprise a material selected from the group consisting of Ta_2O_5 , Ta_3Si_3 , $TaSi_2$, $MoSi_2$, and Mo_5Si_3 , ~~Si_3N_4 , Si_3N_2O , and SiC~~ Mo_5Si_3 .

37. (original) The method of claim 36, further comprising:

- f) prior to said step e), forming a second oxygen barrier layer on said second isolation layer; and
- g) prior to said step e), forming a third isolation layer on said second oxygen barrier layer.

38. (original) A method for making a component, the method comprising:

- a) providing a silicon-based substrate;
- b) forming a first isolation layer on said silicon-based substrate; and
- c) forming a second isolation layer on said first isolation layer,

wherein said first isolation layer consists essentially of Si_3N_4 and said second isolation layer consists essentially of Ta_2O_5 .

39. (original) The method of claim 38, further comprising:

- d) reacting said first isolation layer with said second isolation layer to form, *in situ*, an oxygen barrier layer between said first isolation layer and said second isolation layer.

Appl. No. 10/644,523
Amdt. Dated May 30, 2006
Reply to Office Action of February 28, 2006

40. (original) The method of claim 39, wherein said step d) is performed during service conditions of said component.

41. (currently amended) A method for making a component, the method
5 comprising:
a) providing a silicon-based substrate;
b) forming an isolation layer on said silicon-based substrate;
c) forming a first oxygen barrier layer on said isolation layer; and
d) forming a second oxygen barrier layer on said first oxygen barrier layer,
10 wherein said isolation layer isolates said oxygen barrier layer from said silicon-based substrate, and
wherein said isolation layer is inert to said silicon-based substrate, and wherein
said isolation layer comprises a material selected from the group consisting of
Ta₂O₅, Ta₅Si₃, TaSi₂, MoSi₂, and Mo₅Si₃.

15

42. (canceled)

43. (original) The method of claim 41, wherein said first oxygen barrier layer and said second oxygen barrier layer each comprise a material selected from the group
20 consisting of SiO₂, ScSiO₃, and Sc₂Si₂O₇.

Appl. No. 10/644,523

Amdt. Dated May 30, 2006

Reply to Office Action of February 28, 2006

44. (original) The method of claim 41, wherein said isolation layer provides a barrier to the diffusion of constituents of said silicon-based substrate into said first oxygen barrier layer.

45. (original) The method of claim 41, further comprising:
e) forming an environmental barrier coating on said second oxygen barrier layer.

Appl. No. 10/644,523

Amdt. Dated May 30, 2006

Reply to Office Action of February 28, 2006

46. (original) The method of claim 45, further comprising:
f) forming a thermal barrier coating on said environmental barrier coating.

47. (original) The method of claim 41, wherein said isolation layer, said first oxygen barrier layer, and said second oxygen barrier layer are deposited via a process selected from the group consisting of plasma spray coating, dip coating, sol-gel coating, chemical vapor deposition, physical vapor deposition, and electron beam physical vapor deposition.

48. (original) The method of claim 41, further comprising:
g) forming at least one additional oxygen barrier layer on said second oxygen barrier layer.